STRATEGY RESEARCH PROJECT

NATIONAL SECURITY STRATEGY AND THE MUNITIONS' PARADOX: SELF-SUFFICIENCY OR MAXIMUM EFFICIENCY

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National Security Strategy and the Munitions' Paradox: Self-Sufficiency or Maximum Efficiency

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ABSTRACT

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The dramatic shift in ammunition industrial base preparedness policy has prompted a number of individuals and organizations, both military and civilian, to express alarmist views warning that the United States military strategy may not be credible to likely regional aggressors. Conversely, DoD acquisition leadership believes industry consolidation should continue and the munitions base should be expanded to include US allies.

This paper investigates the Army ammunition readiness posture and modernization plans against a framework of the current and future threats, and contemporary DoD strategy and policy. It also examines prevailing trends toward commercialization and globalization of the munitions industrial base.

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ACKNOWLEDGEMENT

A humble thank you to my wife, Betsy, for her many hours of editing.

To the women and men, civilian and military, who have dedicated their lives to providing the US soldier an abundance of the finest munitions in the world.

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INTRODUCTION

When the cartridges ran out, You could hear the front-ranks shout,
"Hi! Ammunition mules an' Gunga Din!"

-Rudyard Kipling

Ammunition is the critical expendable component of ordnance a soldier wraps a weapon around to create a lethal system to engage and defeat his enemy. The prospect of not having "enough" ammunition has been an emotional issue for soldiers and their commanders since Washington spent the winter at Valley Forge. In every modern major Army campaign there have been reports, real or myth, of inadequate class V stocks that could have potentially jeopardized the mission or unnecessarily risked lives. Students at Fort Leavenworth have dealt with the possibility that the controlled supply rate (CSR) might not meet the required supply rate (RSR) in planning operations since before WWII.

Faced with the possibility of a third world war in Europe, the Army stockpiled over six months worth of ammunition in overseas Preposition Stock Points (PSP) and depots in CONUS.[1] The research and development (R&D) community constantly upgraded the effectiveness of the American ammunition against Soviet counter measures, keeping the production lines warm at all times. One administration after another invested heavily in the Army Ammunition Plants and independent contractors to maintain a surge capability (idle, excess production capacity) to ensure combat soldiers would be provided an endless flow of munitions should the Red Horde ever attempt to push through the Fulda Gap.

But as the bureaucratic walls of the Soviet Union collapsed under its own weight, so the threat of our best enemy disappeared.[2] And with its demise, the Cold War ammunition war reserve requirement dropped 71% in 1994 from a staggering 2.5 million tons needed to support eighteen active divisions in a global war scenario to 725 thousand tons to support ten active divisions in two nearly simultaneous Major Regional Conflicts (MRC). The current stockage objective is 540 thousand tons to support ten active divisions in two nearly simultaneous Major Theater Wars (MTW).[3] The current Defense Planning Guidance (DPG) accepts more risk than in previous years and does not require the Army to maintain a production surge capability. It also extends the replenishment period by approximately more than fifty percent.[4]

The dramatic shift in ammunition industrial base preparedness policy has prompted a number of individuals and organizations, both military and civilian, to express alarmist views warning that the United States (US) military strategy may not be credible to likely regional aggressors.[5] Conversely, DoD acquisition leadership believes industry consolidation should continue and the munitions industrial base (MIB) should be expanded to include US allies. This paper will investigate the Army ammunition readiness posture and modernization plans against a framework of the current and future threats, and contemporary DoD strategy and policy. It will also examine prevailing trends toward commercialization and globalization of the munitions industrial base.

BACKGROUND

We dare not tempt them with weakness. For only when our arms are sufficient can we be certain that they will never be employed.

— President John F. Kennedy

Munitions Industrial Base History

In 1775, the Continental Congress appointed what is now known as the Chief of Ordnance to study methods of arms and ammunition procurement and storage.[6] Two years later, the Board of War and Ordnance established a series of arsenals to manufacture cartridges and gun carriages for the American Revolution.[7] Historians credit this activity as playing a major role in the American Industrial Revolution.[8] For the next 165 years of American military history, the Army arsenals and numerous contractors provided a steady supply of war materiel to the Army.

The arsenals, however, lacked the capacity required by the magnitude of World War II. Consequently, eighty-four Army Ammunition Plants (AAP) were built as part of the national mobilization effort.[9] After the war, the Army inactivated or disposed of most of the AAPs since there was a huge surplus of ammunition and another war seemed remote.[10]

The Korean War caught the US unprepared to rapidly ramp up ammunition production; and had the pace of hostilities seen in 1951 continued into 1952 and 1953, there might well have been ammunition shortages.[11] During the post-Korean era, the Army maintained twelve

AAPs at a minimum production rate and reactivated an additional fourteen to support Vietnam. The Army added a few modernized lines and plants after Vietnam in support of the Cold War and continued to workload a total of seventeen AAPs.

The Industrial Operations Command (IOC) currently manages six government owned contractor operated (GOCO) AAPs and three government owned government operated (GOGO) AAPs.[12] There are also over thirty major private contractor owned contractor operated (COCO) plants.[13]

Recent Developments

During the early 1980s, the American munitions industry experienced substantial growth and benefit by aiding in the containment of Communism. Ninety thousand people were employed at over 280 commercially owned facilities.[14] The Department of Defense (DoD) Procurement Appropriation Ammunition (PAA) reached its high water mark of nearly $6 billion in 1985.[15]

Faced with a staggering national debt, due in part to the significant buildup of the armed forces during the first five Reagan years, Congress passed legislation to significantly reduce Federal expenditures. The DoD budget was cut dramatically to match the reduced threat. The PAA dropped precipitously to $1.4 billion in 1994; a real reduction of 78% while the entire DoD budget dropped only 34% and the total Procurement Appropriation fell 61%.[16] Employment dropped to less than 15,000 people at 52 commercially owned facilities.[17] Approximately 2500 federal

employees now work at the nine sites, primarily the three GOGO plants, and over 6500 contractor personnel are employed at the other six GOCO sites.[18] Table 1 displays the stark change in the MIB in just tens year's time.

	1985	1994
PAA ($ billion)	6	1.4
Employed (ooo)	90	15
Active GOCO/GOGOs	17	9
Commercial facilities	280	52

Table 1

The 1992 DPG significantly changed a number of key assumptions that had served as the basis for justifying a warm munitions industrial base during the Cold War period. The current assumptions are: 1) each conflict will be intense and short in duration (60-120 days); 2) the military will rely on existing stocks for the duration of the conflicts; 3) there will not be a significant surge in ammunition production during the conflicts; and 4) following the conflicts, ammunition items will be replenished to a designated level within a specified time frame, to prepare for the next conflict.[19] Table 2 depicts the difference between the Cold War and post-Cold War DPG assumptions.

	COLD WAR	CURRENT
Type of War	Global	2 Major Theater Wars
Duration	180+ days	60-120 days
Surge requirement	Yes	No
Replenishment	X months	>1.5X months

Table 2

The main impact of the change is that defense ammunition contracts no longer require a clause for a producer to plan for and maintain a surge capability. And while the IOC still monitors the munitions industrial base's total capacity, the extension of the replenishment period somewhat nullifies the need to collect data and maintain contingency plans.

Concerned for their very existence, executives from the surviving private munitions companies and AAP contractor operators formed a non-profit organization dubbed the "Munitions Industrial Base Task Force (MIBTF)" in 1993 to quantify their perceived crisis and communicate its proportion to decision-makers in the Pentagon, the Administration and the Congress.[20] The immediate mission was to stop the "free-fall in munitions funding." After six months of study, the MIBTF concluded that DoD requirements were understated, war reserves were inadequate, industry surge capability was inadequate, replenishment times were excessive, overall funding was inadequate, and the downsizing of the private munitions sector was irrational.[21] The MIBTF initially recommended a funding level of $3 billion per year but quickly withdrew to a more realistic range of $1.8 billion to $2.1 billion per year.[22] While DoD has not submitted a budget in that range, Congress has added funding totaling over $1.5 billion to the President's Budgets for the PAA each year beginning in fiscal year 1994.[23]

According to the DoD Annual Industrial Capabilities Report to Congress, the US defense industrial base is healthy in spite of

significant reductions and downsizing. DoD found very few cases where essential capabilities are endangered. The Pentagon is taking steps to ensure an adequate manufacturing capability in four areas that require monitoring. Army ammunition and missiles were in the group.[24]

In 1996, the Army Materiel Command, Deputy Chief of Staff for Ammunition (AMC-DCS(A)) commissioned a study to provide a comprehensive and independent assessment to serve as a roadmap for how the Army should conduct its future ammunition business. The report's bottom line was that radical measures were necessary including total commercialization of the MIB, application of acquisition reforms, and increased competition through the consolidation of the management function in an acquisition based organization versus a command economy based work-loading headquarters.

CURRENT AND FUTURE THREAT

> *The greatest threat to America today is not Iraq, Iran, North Korea, terrorism, or weapons of mass destruction. It is the potential that we will become too complacent during the time of peace.*
>
> — General Henry Shelton,
> Chairman, Joint Chiefs of Staff

Post Cold-War (1995-2010)

The post Cold-War era presents the US with a dynamic and complex global environment. The turmoil and uncertainty will last at least another decade. The nation has shifted from a "bi-polar" security framework to a more generalized global set of partners,

competitors, and potential adversaries. And in spite of enormous influence and power of the US, threats exist today and others will continue to emerge over time. Assuming the nation's willingness to remain globally engaged remains strong, the US will prevail as the dominant global power politically, economically and militarily.[25]

While the strategic threat of the Soviet era has diminished, the remaining transnational and regional threats are far more difficult to plan for in terms of their tactics, equipment, capabilities and terrain. None of these threats has the technology (except nuclear) capable of competing with the US. The only technological competitors to the US will be its European and Asian allies, and possibly Russia, but none are likely threats for the next fifteen years.[26]

The development and application of the most significant military concepts and technologies in the last ten years has been limited to those advanced western militaries, especially the US, that could afford such upgrades. Since the Cold War, most nations lack the motivation and have emphasized other fiscal priorities besides defense. While the US annually spends $37 billion on R&D and $42 billion on procurement ($60 billion in FY 2001), the entirety of Europe only spends about $11 billion on R&D and $33 billion on procurement.[27] For most non-western countries, combat effectiveness will remain limited due to shortfalls in leadership, maintenance, training, operational concepts and morale.[28] World-

wide arms sales have dropped 50% since 1990 as non-US defense spending has decreased by 40% and modernization budgets (research, development and procurement) have been cut by over 70%.[29]

In his 1998 address to Congress, LTG Patrick Hughes, Director of the Defense Intelligence Agency (DIA), stated that operations other than war (OOTW) will be the most likely engagement over the next ten to fifteen years. Limited local or regional conflicts are possible, but large-scale regional or global war is very unlikely.[30] However, conditions in Iraq, Iran and North Korea demand "constant US vigilance and retention of demonstrable war fighting capabilities."[31]

Future Threat (2010-2025)

As the US enters the next century it will encounter challenges very different from those that molded its national security policy during the last fifty years. Four key courses, simultaneous and interrelated, are driving the change: 1) a geopolitical revolution that will likely see China as a major regional and global player; 2) increased social and demographic pressures on potentially unstable social orders; 3) an emergent interdependent global marketplace touching every nation and society; and 4) a technological revolution that produces information based economies and a world wide revolution in military affairs for moderately wealthy nations.[32]

It is inconceivable that any nation could match the strength and influence of the US in terms of combined political, economic,

technological, military, and cultural power for the next twenty-five years. Five key states, Russia, China, Japan, a European coalition, and India will emerge with significantly more capabilities than other regional powers. We should expect these other major powers to exert influence, both favorable and frustrating to the US, regionally and globally late into the twenty-first century. Although unlikely, there are two possible developments that could pose a dilemma to the US: 1) the formation of anti-US alliances involving two or more of the major powers or 2) an expansion of major power competition from the political-economic to the military sphere.[33] We should recognize that emergent threats from non-major states may not attack the US head on against its overwhelming strength, the basis of the Cold War planning, rather they may use asymmetric forms of warfare to exploit its weak links.[34]

OVERARCHING STRATEGY AND POLICY

> *Only one thing is certain: the greatest danger lies in unwillingness or an inability to change our security posture in time to meet the challenges of the next century.*
>
> — 1997 National Defense Panel

Joint Vision 2010

Joint Vision 2010 provides the overarching "conceptual template for how America's Armed Forces will channel the vitality and innovation of our people and leverage technological opportunities to achieve new levels of effectiveness".[35] While the

basis for the framework is built around improved command, control, and intelligence, the munitions community will play a large role in achieving the four emerging operational concepts: 1) dominant maneuver; 2) precision engagement; 3) full dimensional protection and 4) focused logistics.[36] A key factor in future warfare is long-range precision in unison with a broad range of delivery systems. The ability to create a wider scope of potential weapons effects will enhance the precision capability. These technological advances combined with dominant battle space awareness will produce lethality on the battlefield orders of magnitude over what has been experienced to date.[37]

Quadrennial Defense Review

The Report of the Quadrennial Defense Review (QDR), mandated by the National Defense Authorization Act of 1996, Public Law 104-201, depicts how the Armed Forces will meet the near term requirements while transforming the combat capabilities and structure to meet the future challenges within the projected budgetary constraints.[38] The transformation has four tenets: 1) a focused modernization effort incorporating leading-edge technology; 2) continued exploitation of the "Revolution in Military Affairs" (RMA) for the near term; 3) exploitation of the "Revolution in Business Affairs" (RBA) and 4) insuring against unlikely, but significant, future threats while balancing the need to better position DoD to respond in a timely and effective manner to new threats as they emerge.[39]

The QDR assumes a flat DoD budget for several years out for use in defining the near-term and future strategy and associated force structures. It further forecasts a significant increase in procurement funds from $42.6 billion in the FY 1998 budget to $60 billion in FY 2001.

Three alternative courses of action were evaluated against the above fiscal constraints. Path One focused primarily on near-term demands that maintains a force large and ready to prevail in two MTWs, but defers modernization to the out years. Path Two focused on preparing for a more distant threat now, a global competitor emerging in 2010 to 2015, and risking readiness for the sake of modernization. Path Three balances current demands, accepting moderate risk in some areas, and an uncertain future. The QDR concluded Path Three met the DoD requirements to shape and respond in the near-term, while simultaneously transforming the combat capabilities to prepare for future challenges. While the posture depicted in Path Three has a modicum of risk, DoD believes more effective management of the force and enhancing its capabilities can mitigate the risks.[40]

The QDR modernization decisions directly support efforts to provide maximum capability to the current forces of Joint Vision 2010 and exploit the RMA toward increased current readiness. DoD concluded with regard to deep strike/anti-armor weapons and munitions, consistent with the DoD "Deep Attack Weapons Mix Study", that the present munitions programs, with minor

adjustments, will provide the capability to defeat potential aggressors in the years ahead.[41]

The QDR focus on reengineering and reducing the defense infrastructure for the 21st century is especially relevant. Specifically, the QDR proposes to compete, outsource, or privatize military infrastructure functions that are closely related to commercial enterprises.[42] This aspect of the QDR is critical. Savings generated by the reduction of organic infrastructure will fund a portion of the $60 billion procurement account in FY 2001. If not realized, the DoD investment programs will be curtailed and the force of the future will be hocked to compensate current operations and support bills. DoD will not reap the benefits of the RMA unless we accept the RBA.[43]

National Defense Panel

The National Defense Panel (NDP) was established by the Secretary of Defense in accordance with section 924 of the Military Force Structure Act of 1996, to provide a nonpartisan and independent assessment of the QDR. The assessment was forwarded to Congress along with the Secretary's comments on the report.[44] The fundamental difference between the NDP "Transformation Strategy" and the QDR is the recommended amount of risk the US should assume today to ensure the correct force is available for the future threat. In terms of the QDR, the NDP favors Path Two. The NDP recommends preparing for a maximum engagement of only one

MTW and use the force structure savings to more aggressively develop systems and forces for 2010 now.

Just as salient to the question of this paper is the NDP discussion of transforming the industrial base and reducing DoD infrastructure. The NDP makes seven over arching recommendations for transforming the defense industrial base: 1) pursue commercial-off-the-shelf opportunities; 2) exploit dual-use technologies; 3) achieve and maintain technological superiority through time-based competition; 4) identify and protect military-unique technologies; 5) encourage innovative ideas and penalize pedestrian efforts; 6) develop new rules and procedures that emphasizes technology development and de-emphasizes large production quantities; and 7) review mobilization policy for balance, timeliness, relevance and synchronization.[45] While the MIB argues the first two are not very applicable to their sector, the later five are undeniably relevant.

The US will depend more on a global technology base in the twenty-first century for the process and product technologies needed to develop future defense systems. While a global pool of competent firms will provide economic competition, DoD will also have to compete with commercial markets for much of the global technology base. It will become even more difficult to curb the flow of technology across national borders. As control of specific military-unique technologies becomes more important, comprehensive technology control policies are likely to be ineffective.[46]

DoD procurement strategies should be based on a condition of peace rather than the current Cold War approach. Large production undertakings should only be made in peacetime if hostilities are perceived as imminent and the national will is to field the best available equipment in quantity, a technological plateau is reached and a likely opponent could field an over match system, a key system is reaching obsolescence, or a new design is so prevailing that it can be evolved to meet multiple new uses. This is a major paradigm shift for the defense industrial base and DoD needs to provide industry with incentives to innovate so the US can maintain its technological superiority.[47]

The NPD states DoD should reevaluate the need for certain programs associated with obsolete mobilization concepts against four principles. Mobilization balance stresses that it is better to have the right weapon on hand in adequate numbers rather than to have the capability available to produce it in six months or a year later. Timeliness dictates that policy decisions should only be made <u>if and when</u> a hostile peer competitor emerges. Mobilization policy must be relevant in these times of technological advancement. Neither stored weapons, materials, parts, nor manpower are necessarily relevant to the mobilization needs of future warfare. Mobilization requires synchronization; both equipment <u>and</u> manpower should be available to satisfy CINC war plans.[48]

The NDP also recommends immediate reduction or elimination of Cold War infrastructure. In line with the QDR, the NDP concluded that DoD is burdened with infrastructure that is "ponderous, bureaucratic, and unaffordable" which must be cut to invest the savings in the future. A significant amount of the infrastructure is based upon maintaining an industrial and manpower mobilization base inappropriate to the relatively short wars anticipated in the future or the short technological life cycle currently encountered and certainly to be encountered in 2010. Unfortunately, the NDP capitulates, "DOD managers have little personal incentive to aggressively pursue opportunities for infrastructure streamlining and cost reduction. Such actions are often unpopular among the local workforce, and the Comptroller frequently seizes projected savings before efficiencies are realized. Thus, the current system is heavily biased against innovation and change, and encourages the continuation of inefficient business practices."[49]

Defense Reform Initiative

The Defense Reform Initiative (DRI), an outgrowth product of the QDR, provides DoD an azimuth for implementing the RBA. The DRI asserts there is a common set of principles for reform between industry and DoD: 1) focus the enterprise on a unifying vision; 2) commit the leadership team to change; 3) focus on core competencies; 4) streamline organizations for agility; 5) invest in people; 6) exploit information technology; and 7) break down barriers between organizations.[50]

These guiding principles have shaped the four major areas of reform to the way DoD will do business. The notion of reengineering requires DoD to adopt modern business practices such as shortening cycle times of key processes to achieve world-class standards of performance. The consolidation and streamlining of organizations and missions is necessary to decrease redundancy and maximize synergy. Maximize competition to improve quality, reduce costs, and respond to customers needs. Lastly, eliminate excess support structures to free resources and focus on core competencies.[51] All are applicable in guiding the munitions industrial base into the twenty-first century.

CURRENT POSTURE

> *Thirty-three North Korean tanks advanced toward their position, followed by a column of soldiers--on foot and in trucks-- that snaked for six miles along the hiway... One American lieutenant fired 22 rockets at the advancing tanks. From as close as 15 yards, he scored direct hits, but could not stop the tanks, let alone destroy them. Courage, rifles and bayonets were no match for the tanks and the wave of North Korean infantry behind them. In this short engagement, 185 young Americans were killed, wounded, and captured. The history of Task Force Smith was burned forever into the memory of our Army.*
>
> — LTC Thomas J. Vance

The Army and the defense industrial base have used and abused the engagement of 5 July 1950, to whatever end they desire. Patriotic alarmists believe the war reserve ammunition stockpile is inadequate and what we have are not the "preferred munitions." Alternatively, DoD leadership contends the stockpile is more than

adequate for now and resources should be concentrated in other areas. "Defense choices invariably entail risk; the only question is where we take the risk."[52]

The bottom line is whether or not the Army has "enough" of the "right" ammunition to prosecute its portion of the military component of the US National Security Strategy. The Army Acquisition Executive, in his 1997 Statement to Congress emphasized that "Army forces require ample modern munitions and the assurance that munitions expended in a conflict can be replenished in a timely manner."[53]

The first component in determining sufficiency is to examine how much you need and the validity of the specific requirement determination process. A detailed description of the requirements generation is in Appendix A. The AMC-DCS(A) considers the requirement determination process to be sufficiently rigorous and robust.[54] The AMC-DCS(A) study points out that requirements can change from cycle to cycle due to the introduction of new more effective munitions, updated threat data, and other operational factors. The study expressed concern regarding the impact to the MIB due to the instability caused by the associated resource allocation process.[55]

Enough ammunition

The function of numerical sufficiency is the simple ratio of the available stock on hand versus the requirement. The 99-03 POM stockage objective is 540 thousand tons. As of May 1997 the Army

had over 1.4 million tons of serviceable ammunition in CONUS alone and another 188 thousand tons in overseas locations including Europe, the Pacific, Kuwait, and on PREPO ships.[56] Of course there is not a perfect match of inventory to requirements and according to a GAO study that "while there are shortages of some specific types, overall the services generally have enough ammunition to meet their wartime and peacetime requirements."[57]

The quality of ammunition in storage remains extremely good. The majority of the relevant stockpile was manufactured between 1980 and 1990. The most fragile component in any munition is the propellant or explosive, due to its hygroscopic nature and natural tendency to break down over time. Typical production specifications require a shelf life of twenty years. Even so, surveillance testing reflects that very little deterioration and the Army can expect a continued shelf life of fifteen to twenty more years.

The second aspect of having enough ammunition is the consideration of replenishment, to refill the amount of stockpile of expended inventory after a major theater war over a specified timeframe in a peacetime environment.[58] According to the GAO, "if the key assumptions in the DPG and DoD's industrial base studies are correct, the industrial base will be capable of simultaneously supplying peacetime ammunition needs and replenishing the ammunition stockpile as required, following one or two major regional conflicts."[59] The 1997 Munitions Functional Area

Assessment (FAA) reported only five of the fourteen families of munitions had at least one item that was outside the current DPG replenishment timeframe.[60] Both the GAO and FAA surveys assume all production is done in the US.

The right ammunition

The poignant lesson to glean from the Task Force Smith vignette is the virtue of having some of the right ammunition versus plenty of the wrong. The AMC-DCS(A) funding goal for POM 99-03 is to build a balanced and executable munitions program with moderate risk (relying on substitutes) by: 1) insuring future ammunition development tracks with weapon modernization; 2) procuring fifteen modern items to at least 50% of the procurement objective at a minimum production rate and 3) stabilizing research, development, test and evaluation (RDT&E).[61]

There has always been a difference between the procurement objective for the most modern type of ammunition and the amount of it in the stockpile. A new item gradually displaces the old, which is retained, sold, consumed in training or demilitarized. Dollars available and the urgency of getting the increased capability in the field dictate the rate at which displacement occurs. The previous generation ammunition not yet displaced is designated as a "discretionary" round or substitute. It is issued to the field only after the stock of "preferred" rounds is exhausted.[62] While there is a difference in the performance of the

preferred and the discretionary, the substitute must be capable of defeating the threat to be considered adequate for release.

Research and Development

Integral to the procurement of modern ammunition is the continuous research and development component. While the countermeasure and counter countermeasure spiral race of the Cold War has slowed down significantly, armies continue to pursue inexpensive ways to defeat the US technological over match. One such technology, explosive reactive armor (ERA), is an international growth industry. Several nations, especially the Russians and French, openly advertise that their wares are capable of defeating the American M829A2 kinetic energy (KE) tank round.[63] The Army Research Laboratory announced a non-energetic reactive armor defeated KE rounds in simulation at 5000m/s, becoming more effective the higher the velocity.[64]

Many military technology futurists suggest the US is on the brink of a new generation of weapon systems that will totally obsolete today's systems. "Since the beginning of the industrial revolution, conventional weapons have become 100,000 times more lethal. In short, three distinct lines of military development have converged in our time. Range, speed, and lethality all reach their outer limits at about the same moment of history...this fact alone would justify the term "revolution in warfare." [65] We have reached the technological and physical limitations of black

powder, nitroglycerin, nitrocellulose and composition B, and we continue to invest too much for too little additional capability.

The Army's top R&D priority is "digitization of the force, even above Comanche and Crusader, and it is becoming a large sucking black hole."[66] Modernization is focusing on upgrading platforms, giving little credence to leap ahead technology in the munitions arena.

> "On the weapons front, we need to stop buying the latest variant of the M4 Sherman tank and put every cent we can scrounge into bold research and development so that our Army After Next will not be an Army Like The Last. There are revolutionary technologies coming -- from space-based artillery to sonic, broadcast and behavior-control weapons -- which could alter conventional warfare as not even the advents of the stirrup, gunpowder or atom bomb have done."[67]

The focus of the Army After Next (AAN) "shifts from improvement of fielded capabilities to long-term research and development programs; and from current and programmed force structures to as yet unspecified capabilities associated with our emerging vision of future warfare."[68] Even Congress has gone on record stating DoD must "shift our emphasis to aggressively developing future capabilities."[69]

The problem is the structure of the Defense budget. The administration and Congress plan to increase major weapon system purchases by almost 40% by 2002 while funding for R&D is projected to decline by 15% during the same period.[70] The Army's RDT&E line has been basically flat for the last ten years.[71] The DoD POM 99-03 gives the Army $23 billion of the total $175 billion RDTE

budget. The munitions slice is $2.7 billion, approximately $540 million per year for all levels of research.[72] Basic and applied research for ammunition is only funded at $165 million per year.

While the DoD specific portion of the RDTE account is $44 billion, almost nothing is spent on future munitions. The current Defense Science and Technology Strategy focuses primarily on dual-use technologies to which the munitions research contributes very little to offer. The strategy acknowledges "an important caveat to emphasize on joint operations and dual-use is that there will remain technologies and industries that will not be incorporated in joint operations or sustained by commercial markets, but are nevertheless critical to the warfighters…and will never transition enough commercially viable products to sustain development without DOD leadership." However, "the military department must bear the cost and the responsibility for advancing these technologies and nurturing the research and development component of those industries."[73]

R&D organizations do not instinctively produce an innovative product but must have justifiable motivation. Innovation usually entails a challenge initiated by an external threat, an unexploited revolutionary technology possessing broad military application, an unsolved state of the art critical requirement, or a corporation's motivation to win a competitive procurement. Without the resources to provide the motivation to search for the technology for the next generation of munitions, young bright

scientists and engineers will migrate to other industries. Maintaining a youthful, creative and motivated workforce in this arena, both government and commercial could prove to be the single biggest shortfall in obtaining the AAN goals for lethality.

FUTURE TRENDS

> *The basic need of every company is to make a profit. Only then can it provide jobs and earnings for employees.*
>
> — I.W. Abel, United Steelworkers of America

Commercialization

While both the QDR and the NDP call for the elimination of DoD infrastructure and maximum commercialization of functions, neither specifies the AAPs or the MIB. The documents also state that DoD must maintain those defense distinct capabilities, but they do not stipulate if commercial capacity alone is sufficient.

In 1991, recognizing the down turn in ammunition production requirements, the US Army Armaments, Munitions and Chemical Command (AMCCOM) initiated a consolidation action of the AAPs, both active and inactive. The "Facility Strategy for the 21st Century" (AMMO-FAST-21) sought to supply a vision and framework to assist in the rational resizing of the MIB. The framework includes a logical methodology for resolving workloading, manufacturing facilities retention, investment, maintenance, disposing of assets and a host of other resource consuming issues.[74] The sunk cost value of the real estate and capital assets of all the active and inactive AAPs is estimated at $30B.[75]

If a portion of the base is not needed for replenishment or technology/R&D purposes, it is considered excess. AMMO-FAST-21 is a reasonable approach if no US commercial source is available to provide the replenishment production.[76]

Private industry participation has grown significantly in the last thirty years and now makes up seventy percent of the MIB.[77] IOC workloads the remaining thirty percent to the nine GOCO/GOGO AAPs. In the 1980s, AMCCOM began using a Restricted Specified Base (RSB) to ensure it could meet mobilization requirements.[78] The RSB was designed to workload the commercial portion of the base. It is composed of companies that specialize in specific families of ammunition (fuzes, mortars, artillery, etc.) who commit to specific terms and conditions for maintaining capability for possible use during a replenishment period and in turn are the only suppliers to be offered work.[79] This arrangement is also known as "managed competition" by both the government and private sectors and is the preferred way to do business for the MIBTF.[80]

Congress appropriated $98 million in 1993, $44M in 1996 and $45 million in 1997 for Armament Retooling and Manufacturing Support (ARMS) to encourage Army facility contractors to market idle capacity at the AAPs for work.[81] The funding was in recognition of the aging inactive AAPs that were still required for replenishment production. Over 125 tenants at 7 sights have signed leases and are contributing to the reduction of overhead and maintenance.[82] The end result was supposed to be lower cost to

the government to operate and maintain the AAPs with other than ammunition production. According to a 1997 US Army Audit Agency (USAAA) report, the minimal annual return is not being achieved and while the program has the potential to reduce costs further, policies and procedures that IOC used to execute the program need improvement. USAAA further stated that "it could become more of a liability than an asset to the Army."[83]

The "Recommended Strategy for Configuring and Managing the US Munitions Industrial Base" study produced for the AMC-DCS(A) concluded that the government munitions production base should be transitioned in its entirety to the private sector. The three main reasons were: 1) eliminate the government's liability and cost of owning the production base; 2) build a free and open marketplace and 3) benefit from market forces and private capital.[84] Opposing views between the executive branch and the Congress have made it difficult to sort out the effect of competitive acquisition policy on all tiers of the defense base.[85] In the end, industrial activities the government currently performs must shift to private industry where profit motive can be used to achieve higher utilization.[86]

With the complete divestiture of government munitions production, private industry would finance, own (or lease), and operate all production assets. The government would keep title to the real estate at a few key AAPs to maintain the capability to perform production requiring significant acreage for quantity

distance considerations. The sites would be managed by a commercial agent who would be responsible for generating revenues by attracting tenants to make use of the facilities. The commercial MIB would choose whether to utilize the existing AAPs based purely upon the economics of the decision.

Army leadership skeptics claim that placing the entire ammunition production capability in the private sector is too risky a proposition. Their standard defense is how will the Army obtain the extra production capacity if it needs it. They know that commercial investment decisions are based primarily upon return on assets. The biggest problem facing the MIB is the inability to efficiently match production capability to production requirements. While fixed firm price (FFP) contracts provide private industry good near term planning, they have little visibility or influence of the long term. Commercial production lines are designed and equipped for single year buys. Minimal automation is purchased and extensive manual labor remains the norm.[87] If commercial industry is the sole producer, then production capacity will contract to meet the peacetime needs and be incapable of expanding quickly during a crisis.

The benefits of a 100% commercial MIB are in line with the AMC-DCS(A) study. The government does not have to maintain an active base, business is profit motivated and demand supported not command workloaded, and open competition increases quality and timeliness. Other benefits include being able to keep the

developer and producer in the same organization and being able to apply best business practices to the process. Also the contractor serves as systems integrator eliminating the requirement for "government furnished equipment" and the Army having to pay for costly idle down time. There is an innate sense of mastering their own destiny when an organization can flex their muscle to compete versus standing in line for the next work package to be handed out.

Globalization

Self-sufficiency has always been a basic tenet of national security policy. In 1791 Alexander Hamilton, in his influential "Report on Manufacturers," recommended the development of a domestic industrial base to avoid excessive reliance on foreign suppliers.[88] One hundred years later and an ocean apart, British Professor W.A.S. Hewin questioned,

> "Suppose an industry which is threatened (by foreign competition) is one which lies at the very root of your system of National Defence, where are you then? You could not get on without an iron industry, a great Engineering trade, because in modern warfare you would not have the means of producing, and maintaining in a state of efficiency, your fleets and armies."[89]

It is this very logic and sentiment that many use today in this post Cold War era to keep the walls of protectionism around the US defense industrial base.

In contrast, the number three strategic priority in the President's National Security Strategy for a New Century, is to have America prosper in the global economy, reduce trade barriers,

especially with Europe, and create a new transatlantic marketplace.[90] Dr. Paul Kaminski, the Under Secretary of Defense for Acquisition and Technology (USD,A&T), set the stage for post Cold War armaments cooperation, stating "we will have to leverage not only the commercial sector, but also the industrial base of our friends and allies to gain the needed economic base to modernize the equipment of the defense forces...We are looking for best value, wherever it is located in the world."[91] Other economists have echoed, "If they (NATO) are our strategic allies then it (the alliance) should be economic as well as military. It is to our benefit that Europe has a healthy defense industry."[92]

Even the legislature recognizes the need to reduce trade barriers and expand the US base of operations. Congress recently passed the McCain amendment, granting the Secretary of Defense authority to waive the Buy America Act, a relic of the Great Depression, with countries where DoD has established Memorandums of Understanding (MOUs) with reciprocal rights.[93] Unfortunately it will be these same Congressmen that will balk when their constituents lose jobs to the global competition efforts of the executive branch. The Virginia state delegation, for example, successfully influenced the termination of a contract for tank propellant with EXPRO of Canada, a full member of the US "industrial base," so the business could go to the under utilized and ailing Radford AAP.

The rest of the world is more than willing to accept the US as a trading partner in armaments. Over forty countries worldwide have significant capabilities to produce, market, and develop modern munitions.[94] The world is booming with third world producers. China, North Korea, Israel, Brazil, Egypt, Pakistan, South Africa, India, and Singapore are but some of the weapons export leaders.[95] The international market is increasingly driven by purely economic considerations. This means the attitudes and practice of arms manufacturers may increasingly resemble their civilian counterparts in price and quality.[96] It also means that as companies and states are becoming more interdependent, the act of imposing an embargo will not be practical as a political sanction.

The global arms market of the last forty years is undergoing a significant metamorphosis and restructuring and will continue to consolidate globally to three to five major corporations per product group. Defense firms worldwide are frequently entering strategic transnational business alliances for technical, financial and competitive reasons. They are attempting to share costs, reduce development risks, gain access to foreign technology (especially one-of-a-kind R&D centers), obtain economy of scale, penetrate new markets, increase interoperability, and foster international cooperation.[97]

US defense companies are also no strangers to the world arms market. In 1996, the US accounted for 36% of the total $32

billion in global business. US companies exported $11.3 billion in arms, $7.3 billion to developing nations. The US did more business than the next five competitors combined.[98] For US defense companies to compete on a global basis, they must be able to sell abroad without overly restrictive barriers. Where US arms trade was once a tool of the State Department, it now receives an economic consideration and the US government is assisting in that endeavor.[99] Presidential Decision Directive 34 states "the US Government will explicitly consider the economic impact to the US arms industry as one of the criteria for deciding whether to approve an export request."[100] The dominant criterion for DoD still remains the impact to national security. Because of the protectionist legislation of the past, arms business has typically only flowed one way.

If the Army desired foreign arms technology during the Cold War era, it was required to purchase a license to use a technical data package to produce the weapon system or munition here in the US. Rarely has the Army simply just bought an item, such as the Ranger Anti-tank Weapon System (RAWS), from abroad. Rarely did this policy prove productive. There are numerous examples that demonstrate the Army's inability to take a proven weapon system design, build the tools for manufacturing and then successfully produce it.

It would seem the most likely partners in establishing a mutually supporting munitions industrial base for the US would be

with the other members of the North Atlantic Treaty Organization (NATO). The European countries have been just as concerned as the US about the notion of self-sufficiency during the Cold War. The European ammunition industry has received significant governmental subsidies during this transition period. Their consolidation of capacity has followed a more socialistic road than that of the US. It now appears that the governments of Europe are ready to face up to reality, and to do what is necessary to begin assisting these companies in the painful process of down sizing and international integration.[101] The UK was the first to totally privatize their MIB and has divested Royal Ordnance. Since privatization, Royal Ordnance has reduced their prices by 30%. France and others in NATO also appear ready to privatize state owned defense industries.

Although NATO provides guidance on war reserves and replenishment requirements for different degrees of war, each country does as it sees prudent.[102] The NATO Maintenance and Supply Agency (NAMSA) was chartered to facilitate consolidation of requirements in multiple nation ammunition procurement to achieve economies of scale. When Alliance members procure through NAMSA, they must agree to completely open competition throughout NATO (both ways). Most countries still do procurement through their own industry. And ironically, if they do go foreign it is usually outside NATO.[103]

The NATO Industrial Planning Committee conducted a NATO Ammunition Study to assess the Alliance's capability and to identify inhibitors to replenishment. The study identified significant problems, especially the degree of dependency of the base on "foreign" suppliers, many in the former WARSAW pact. While the US has portrayed a rigid protectionist outward appearance, it is no different. DoD has always been dependent on support from foreign countries, especially in components and raw materials. Although initially considered a national crisis, importing hi tech components for weapons from Japan has become commonplace. Even if DoD focused on the assembly site in accordance with the Buy America Act, it is nearly impossible to state where a product is made because of the international entanglements in today's commercial world.

The trend still continues as Eastern European nations supply a substantial number of metal parts and explosive materials.[104] European companies are beginning to cross boundaries and acquire or merge with other munitions companies. A recent example is the acquisition by Royal Ordnance of Muiden Chemie in the Netherlands and Heckler and Koch in Germany.[105]

NATO Committee for National Armaments Directors (CNAD) concluded it was best for all members to remove barriers from free trade. They acknowledged that it could only be achieved on a one-to-one reciprocal basis. The CNAD published the NATO Code of Conduct of Defense Trade to achieve commitments to transparent and

non-discriminatory government procurement practices. In 1995, Dr. Kaminski directed DoD to only use competitive procedures for armaments contracts over $50 million to promote consistency and fairness in dealing with US allies. Also for any competition over $10 million where the low responsible bid did not win, DoD would debrief officials of that country's embassy.[106]

The IOC, contrary to Dr. Kaminski's guidance, is presently using its own management tool for determining the level of competition to be allowed in ammunition procurement. There are three risk levels, based on a self-imposed requirement to "nurture" the MIB, which then prescribe the breadth of the competition. If there is plenty of business and multiple suppliers exist in the US, the procurement is considered low risk and competed on a "free and open" basis. If there is limited business and only a few suppliers in the US, the bid is considered medium risk and limited to the US and Canada. If there is limited business and only one or two suppliers in the RSB, the bid is considered high risk and limited to the RSB.[107] With current austere budgets, it is unlikely a foreign source would ever be entertained except as a gratuitous statistic.

In November 1997, several of the larger members of the European Union, UK, Germany, France and Italy, established a European Armaments Procurement Agency (EAPA) with the intent to consolidate requirements and their defense industrial base to achieve economies of scale. The US is still undecided as to

whether this action is going to be a benefit or the formation of a Fortress Europe, something of which the US has long been accused.[108]

For all the maneuvering and reorganizing, the members of the EAPA are no better off than the US MIB. There simply are still too many global vendors with too many products.[109] As the wealthy nations of the world enter into the knowledge age, the low rate production of ammunition is going to become too expensive to remain self-sufficient. Expensive in terms of manufacturing cost and a host of social issues such as emissions requirements, the environment, safety and even morality in the form of arms proliferation. Repressive government regulations and practices and general lack of tax incentives will have the healthier companies looking even more to foreign sources for the majority of materials and components and keep only the most lucrative activities in the home land.[110]

CONCLUSIONS

Progress occurs when courageous, skillful leaders seize the opportunity to change things for the better.

— President Harry S. Truman

The women and men, civilian and military, of the American Munitions Industrial Base have served their nation well and can be proud that they played a major part in the containment and ultimate defeat of Communism. They are now caught in an unappreciative munitions paradox. As patriotic capitalists, they

wish to ensure America's sons and daughters have plenty of quality ammunition to fight its next wars, but they cling to unaffordable and obsolete mobilization policies and business practices that will eventually lead to the downfall of their industry. They want to maintain a system of command economics they fought so hard to crush elsewhere in the world. The Munitions Industrial Base stands at a critical juncture in their history, one similar to the automobile and electronics industry of the 1960s. Unfortunately for them, "A new civilization is emerging in our lives, and blind men everywhere are trying to suppress it."[111]

The US is in a strategic pause and unless there is a dramatic change in the world order, it will remain in such for several years to come. Current threats are significantly diminished from that of the Cold War era. With the reduced threat there is no longer a requirement to store huge amounts of ammunition for mobilization. Nor is there a requirement to maintain idle production capacity for ammunition "just in case". Arguments that attempt to overlay the 1950 Korean War on top of the current situation are founded more in hysteria than in fact. The likelihood of two major theater wars is remote. Just as unlikely is the emergence of a well-trained, well-equipped and "ready" regional great power.[112]

Although nearly a decade has passed since the conclusion of the Cold War, DoD and the defense industrial base are still cautiously transitioning to the new era. "The rearward looking,

indeterminate descriptor of an international security environment cannot be perpetuated indefinitely."[113] Paul Kennedy states in Preparing for the Twenty-First Century:

> During the Cold War tensions, it was of course easy to argue that threats to one's people were primarily military in nature, and that the nation-state remained the central actor in world affairs. Even with the conflict removed, national security experts and Pentagon officials can still find many potential threats to international stability-and grounds for maintaining large defense forces...These traditional assumptions are coming under increasing pressure, however, simply because of the way our world is changing. With the Cold War over, many writers now argue that military rivalries and arms races are being replaced by economic rivalrism, technology races, and various forms of commercial warfare.[114]

This is the first time in fifty years that the US has more than ample ammunition to execute its military strategy. The QDR, two GAO audits and numerous other studies substantiate that the Army indeed has sufficient quality ammunition and replenishment capacity. The Army plan to judiciously upgrade the stockpile with modern ammunition reflects moderate risk in line with the National Military Strategy. This level of readiness the Army now enjoys provides it with a rare opportunity to turn its attention toward shaping the future.

During this transition period, the Army must fundamentally reshape the MIB to insure it is a healthy and robust enterprise to meet the future needs. This requires a radical change in the way it does business. The QDR and the NDP affirmed the need to significantly reduce government infrastructure and transfer functions being performed by the government to industry.

Government should not be in the business of doing those activities that the corporate world does better, faster and cheaper. The Army should provide insight and not oversight in the ammunition development and production profession. Private industry can produce quality ammunition at a minimum 30% cost savings.[115] Competition drives innovation in technology and cost efficiency. The cost to maintain the aged and deteriorating AAPs has far outstripped the necessity of keeping them available for a "just in case" war.

National and global momentum for reducing barriers to free trade is advancing quickly. "In coming decades, the US can only preserve its current technological advantage through time-base competition."[116] With the reduction of DoD modernization budgets and follow on protracted consolidation of the MIB, it is imperative the Army expand its industrial base partners to include the NATO MIB at a minimum. Low-tech munitions should be considered just another commodity and bought from the best value source anywhere. Opening the US borders for free trade will benefit the Army as well as the US allies.

A primary contributor to the Army's success on the future battlefield is maintaining a superior technological edge over future threat. While Joint Vision 2010 provides a clear objective and roadmap, it is based on the evolutionary process of improving existing systems and force structure in a resource constrained time frame.[117] In contrast, the Army After Next endeavor deals

with the potential future threat of 2015 to 2025 that requires a revolutionary change. The focus will be on long-term research and development programs rather than enhancements to existing systems and the as of yet unspecified force that would employ the next generation of weapon systems.[118]

Now is the time to significantly invest in ammunition R&D. According to the "Recommended Strategy for Configuring and Managing the US Munitions Industrial Base" the tech base is the greatest asset in the US MIB.[119] The Army requires the best and brightest to develop the munitions and armaments for 2015. To keep this talent and encourage a youthful migration into this field, the Army must provide the incentive for innovation through a motivational challenge and adequate resources.

The highest hurdle for the MIB to clear in order for it to move forward in a positive direction is political in nature. Should the MIB continue to pursue a protectionist based survival strategy, dependent on their Congressmen for the next job, it will perpetuate their closed circle and lead to their eventual demise. Should the MIB accept the new world order and invest in innovation and efficiency, it will continue to aid in the defense of the free world.

RECOMMENDATIONS

Ultimately, we must always be assured of victory and certain we will never be focused to negotiate from a position of weakness.

— General Dennis Reimer,
Army Chief of Staff

The Army should continue to accept moderate risk in procuring modern munitions but fully fund procurement of training ammunition. The procurement should be done in cost effective production units with minimal concern for MIB capacity retention issues.

The Army should focus on its core competencies and get out of the production business entirely. Commercialization of the AAPs will allow profit motivated efficiency to guide sizing of the MIB. The Army must divest as many AAPs as possible to reduce the burden of maintaining underutilized facilities. Contractors should be allowed to rent land and facilities at their discretion.

DoD should allow competition to be the driving force in the procurement of ammunition. As the MIB continues to consolidate, DoD should support further industrial mergers and acquisitions. DoD should also encourage the MIB to look globally for new partners and opportunities to expand their base. In this vein, DoD must loosen their grip on "critical technologies" and keep control of only those truly leading edge technologies.

The Army should manage in an acquisition style, not management by workload. Project Managers should look globally for munitions

whenever possible and develop partnerships with R&D companies who are competent producers.

DoD must reduce regulations and program fluctuations that inhibit stability in the MIB. As much as is practical, DoD should freely share future plans and budgetary information with the American MIB to assist in their investment decisions. DoD should also support providing the MIB tax incentives to promote capital investment.

The Army needs to increase funding to Research and Development for the weapons and munitions for the 2015 force. Continuous increases in munitions lethality are also the most cost effective way to upgrade a weapon system. DoD should shift significant funds from their Research and Development assets that are only focused on dual-use technologies to those defense specific technologies that are needed for the future warfighters.

DoD should investigate consolidating all service ammunition centers and missions into one. Of particular concern is the aging of tech base workforce and the barriers to entry by young talented individuals. DoD should promote innovation by allowing Research and Development contracts to be more lucrative to the MIB where production is not forth coming.

Appendix A: Requirements Generation Process

The DPG prescribes the use of the Capabilities Based Munitions Requirements (CBMR) process to plan for two nearly simultaneous MRCs.[120] The Commanders in Chief (CINCs), utilizing the DIA Outyear Threat Report (OTR), develop a Threat Distribution Plan (TDP) against forces outlined in the DPG Illustrative Planning Scenarios (IPS).[121]

The CINCs plan is validated by the Joint Staff and provided to the services along with the Operational Planning Factors (OPF), the Strategic Planning Factors (SPF) and the Phased Threat Distributions (PTD) that assign target quantities to each Service. Each service then individually computes the quantities by type of munition and passes the information to the Single Manager for Conventional Ammunition.

The US Army Concepts Analysis Agency (USACAA) models the Army warfight and produces a figure that includes the projected consumption plus the initial fill combat load plus the sustainment requirement, the stock to fill the logistics system pipeline, and a readiness and strategic reserve.[122] Losses are modeled at both the intra-theater and strategic level. The bottom line in the CBMR methodology is to calculate three essential elements of analysis: to get X kills, a component must consume Y munitions, and to consume Y munitions, a component requires delivery of Z munitions.[123]

As with any product of modeling, a sanity check is required to ensure fidelity and robustness of the output. Subject matter experts, the Army Requirements Working Group (ARWG) and a General Officer Steering Committee (GOSC) chaired by the Deputy Chief of Staff for Operations and Plans (DCSOPS) review the draft product. The corrected inputs are provided to the final product.[124] The USACAA number represents the war reserve portion of the total procurement objective, determined by the DCSOPS, for the Program Objective Memorandum (POM) build.

ENDNOTES

[1] United States General Accounting Office, *Ammunition Industrial Base, Information on DoD's Assessment of Requirements, NSIAD-96-133* (Washington: Government Printing Office, 31 May 1996), page 2.

[2] Colin Powell, My American Journey (New York: Ballantine Books, 1995), page 424.

[3] United States Army, Army Material Command, *Munitions Functional Area Assessment*, 1 April 1997.

[4] United States General Accounting Office, page 2.

[5] Science Applications International Corporation, *Strategic Requirements for the US Munitions Industrial Base* (Arlington: Strategic Assessment Center, 2 February 1994), page 4.

[6] Personnel Command, *About the Ordnance Corps*, available from http://www.perscom.army.mil; Internet; accessed on 16 April.

[7] National Park Service, History of the Springfield Armory, available from http:www.nps.springfield.com; Internet; accessed on 16 April.

[8] Personnel Command.

[9] United States Army, Army Material Command, "Reshape So Far."

[10] Jim Courter, Steve L. Davis and Loren B. Thompson, "US Military Ammunition Policy: Reliving the Mistakes of the Past," *Parameters*, Autumn 1994, page 106.

[11] Jim Courter, page 107.

[12] The three GOGO installations also perform a munitions storage mission.

[13] United States Army, Army Material Command, "Reshape So Far."

[14] LTC Moses Whitehurst, *The Munitions Industrial Base: Past, Present and Future*, April 1997, page 8.

[15] Munitions Industrial Base Task Force, *Briefing for Members of Congress*, 13 January 1998, page 13.

[16] Munitions Industrial Base Task Force, page 16.

[17] LTC Moses Whitehurst, page 8.

[18] Industrial Operation Command, *IOC Manpower-FY98*, available from http://www.ioc.army.mil/rm/iocfact/auth-man.htm; Internet; accessed 18 January 1998.

[19] United States General Accounting Office, page 3.

[20] Science Applications International Corporation, *Munitions Industrial Base Forecast* (Arlington: Strategic Assessment Center, 21 October 1993), page i.

[21] Ibid., page 1.

[22] John Donnelly, "Munitions Industry Blows up Over Funding Shortfalls," *Defense Week*, 9 September 1996.

[23] LTC Moses Whitehurst, page 10.

[24] Bryan Bender, "Pentagon Says Defense Industrial Base in Good Shape," *Defense Daily*, 6 March 1997.

[25] LTG Patrick Hughes, *Global Threats and Challenges: The Decade Ahead*, 28 January 1998, available from http:www.dia.mil/dr_ssciu.Html; Internet; accessed 15 March 1998, page 2.

[26] Ibid., page 5.

[27] William Cohen, *NATO at 50: New Challenges in a New Age*, 8 February 1998, available from http://www.defenselink.mil/news/Feb1998.html; Internet; accessed 16 March 1998.

[28] Ibid., page 20.

[29] Ibid., page 18.

[30] LTG Patrick Hughes, page 7.

[31] Ibid., page 22.

[32] National Defense Panel, *Transforming Defense: National Security in the 21st Century*, December 1997, page 5.

[33] LTG Patrick Hughes, page 8.

[34] Jacques S. Gansler "Realizing Acquisition Reform," *Program Manager*, January/February 1998, page 2.

[35] General John M. Shalikashvili, *Joint Vision 2010*, May 1996, page 1.

[36] Ibid., page 19.

[37] Ibid., page 13.

[38] *The Legislation*, available from http://www.defenselink.mil/topstory/quad_leg.htm; Internet; page 1.

[39] William Cohen, *Report of the Quadrennial Defense Review*, May 1997, section III, page 10.

[40] Ibid., section VII, page 1.

[41] Ibid., section VII, page 11.

[42] Ibid., section VIII, page 4.

[43] Ibid., section IX, page 3.

[44] *The Legislation*, page 5.

[45] William Cohen, page 78.

[46] Ibid., page 74.

[47] Ibid., page 76.

[48] Ibid., page 77.

[49] Ibid., page 79.

[50] William Cohen, *Defense Reform Initiative*, October 1997, page iii.

[51] Ibid.

[52] National Defense Panel, page ii.

[53] Honorable Gilbert Decker, *Statement to Congress by the Honorable Gilbert F. Decker, Assistant Secretary of the Army for Research, Development and Acquisition and Lieutenant General Ronald V Hite, Military Deputy to the Assistant Secretary of the Army for Research, Development and Acquisition*, 11 March 1997,

available from http:www.house.gov/nsc/97-3-11Decker.htm; Internet; accessed 13 January 1998, page 16.

[54] United States Army, Army Material Command, "Requirements."

[55] T. J. Doherty and R. E. Rhoads, *Recommended Strategy for Configuring and Managing the US Munitions Industrial Base*, June 1997, page 5.

[56] United States Army, Army Material Command, "Wholesale Stockpile."

[57] United States General Accounting Office, *Defense Ammunition, Significant Problems Left Unattended Will get Worse, NSAID-96-129* (Washington: Government Printing Office, 21 June 1996), page 3.

[58] Janik, Richard W., *Exploring Changes to the Ammunition Industrial Base: Facing the Future or Facing Reality*, 24 September 1997, page 2.

[59] United States General Accounting Office, page 6.

[60] United States Army, Army Material Command, "Replenishment."

[61] Ibid., "Introduction."

[62] LTC Moses Whitehurst, page 5.

[63] SNPE Explosives and Propellants, *Reactive Armour*, available from http://www.army-technology.com/contractors/camoflage/snpe/index.html; Internet; accessed on 15 March 1998.

[64] United States Army Advanced Research Laboratory, "Armor/ Armaments", *Annual Review of 96 Technical Highlights*, available from http://info.arl.army.mil/EA/armor96.html; Internet; accessed 15 March 1998.

[65] Alvin and Heidi Toffler, War and Anti-War, New York: Warner Books, 1993, page 33.

[66] George Williams, Lecture to Senior Service College Fellows, University of Texas, 4 April 1998.

[67] LTC (retired) Ralph Peters, "Ruinous General: Heroes Gone Astray," *Army Times*, 16 February 1998.

[68] Department of the Army, *The Annual Report on the Army After Next Project to the Chief of Staff of the Army*, July 1997, page 7.

[69] Coats, Dan and Lieberman, Joseph, "A Reformed Military for the 21st Century", *Washington Times*, 1 December 1997, page 23.

[70] Ellsworth, Robert, "American National Security in the Early 21st Century," *US National Security: Beyond the Cold War* (Carlisle Barracks: Strategic Studies Institute, 26 July 1997), page 107.

[71] Institute of Land Warfare, Association of the United States Army, *Army Budget Fiscal Year 1998, An Analysis* (Washington, July 1997), page 51.

[72] United States Army, Army Material Command, "Munitions RDTE."

[73] Department of Defense, *Defense Science and Technology Strategy*, May 1996, pages 32-33.

[74] LTC Moses Whitehurst, pages 11-12.

[75] United States Army, Army Material Command, "Reshape So Far."

[76] T. J. Doherty and R. E. Rhoads, *Analysis Supporting Recommended Strategy for Configuring and Managing the US Munitions Industrial Base*, April 1997, page 4.11.

[77] Courter, page 100.

[78] In the early 1980s AMCCOM was ARMCOM.

[79] United States Army Audit Agency, *Reforming Ammunition Procurement-Phase I*, 20 March 1997, page 4.

[80] Science Applications International Corporation, page 3.

[81] United States Army Audit Agency, page 4.

[82] United States Army Public Affairs, *Army's Call to ARMS Offers a Model for Defense Conversion*, 2 December 1996.

[83] United States Army Audit Agency, page 22.

[84] T. J. Doherty and R. E. Rhoads, page 23.

[85] LTC Paul Wolfgram, *The Peace Dividend: An Analysis of the Effect of the New DoD Acquisition Policy on the Defense Industrial Base*, 25 May 1993, page ii.

[86] Jacques S. Gansler, The Defense Industry (Cambridge: The MIT Press, 1985), page 256.

[87] T. J. Doherty and R. E. Rhoads, page 4.23.

[88] Jacques S. Gansler, Defense Conversion: Transforming the Arsenal of Democracy (Cambridge: The MIT Press, 1995), page 43.

[89] Paul Kennedy, The Rise and Fall of Great Powers: Economic Change and Military Conflict from 1500 to 2000 (New York: Vintage Books, January 1989), page 530.

[90]The White House, *A National Security Strategy for a New Century*, May 1997, page 16.

[91] Paul G. Kaminski, *Preparing for the 105th Congress*, 13 November 1996, available from http://www.acq.osd.mil/ousda/speech/105th_congress.html; Internet; accessed 17 December 1997, page 7.

[92] George Kozmetsky, Global Economic Competition (Boston: Kluwer Academic Publishers, 1997), page 6.

[93] Paul G. Kaminski, page 7.

[94] Department of Defense, Armaments Cooperation, *Military Critical Technologies List and Assessment*, available from http://www.acq.osd.mil/icp/armscoop.html; Internet; accessed 14 March 1998, page 1.

[95] Richard, Thrale, "The Future of the Defense Industry: Remaining Competitive in the International Marketplace," Essays on Strategy (IX) (Washington: National Defense University Press, 1993), page 168.

[96] Ibid., page 171.

[97]Andrew Hull, "Trends in the Arms Market," *Jane's Intelligence Review*, 1 May 1997, page 1.

[98] Jennifer Rothacker, *In 1996, US Finished First in Arms Sales*, Associated Press, 17 August 1997.

[99] Andrew Hull, page 6.

[100] Ibid., page 7.

[101] Trevour Nash, "Armored Enigma in Europe," *Armed Forces Journal International*, May 1996 page 46.

[102] T. J. Doherty and R. E. Rhoads, page 6.25.

[103] Ibid., page 6.22.

[104] Ibid., page 6.21.

[105] Ibid., page6.25.

[106] Ibid., page 6.22.

[107] Industrial Operation Command, *Conventional Ammunition Base Campaign Plan*, received fax 10 February 1998.

[108] Paul Kaminski, page 7.

[109] Jack Kerrigan, "Message from the Publisher," *Defense News*, 6 August 1995, page 3.

[110] Richard Thrale, page 171.

[111] Alvin and Heidi Toffler, The Third Wave (New York: Bantam Books, 1980), page 1.

[112] LTG Patrick Hughes, page 18.

[113] Douglas C. Lovelace, *The Evolution in Military Affairs: Shaping the Future US Armed Forces*, 16 June 1997, available from http.www.milnet.com/milnet/mil97/emap1.htm; Internet; accessed 17 February 1998.

[114] Paul Kennedy, Preparing for the Twenty-First Century (New York: Vintage Books, 1993), page 127.

[115] Industrial Operation Command, *Industrial Operation Command - Strategic Plan 97*, available from http://www.ioc.army.mil/ea/strat/oldstra; Internet; accessed 9 March 1998, Page 13.

[116] National Defense Panel, page vi.

[117] Ibid., page 34.

[118] Department of the Army, p7.

[119] T. J. Doherty and R. E. Rhoads, *Recommended Strategy for Configuring and Managing the US Munitions Industrial Base*, page 9.

[120] Follow on DPGs will replace the term MRC with MTW per the QDR.

[121] T. J. Doherty and R. E. Rhoads, *Analysis Supporting Recommended Strategy for Configuring and Managing the US Munitions Industrial Base*, page 3.2.

[122] United States Army Concepts Analysis Agency, *Briefing to the General Officer Steering Committee*, January 1998, page 1-22.

[123] Ibid., page 1-2.

[124] T. J. Doherty and R. E. Rhoads, page 3.3.

BIBLIOGRAPHY

Aerospace Daily, "Pentagon Believes Ammo Industrial Base is Adequate, GAO Says," 4 June 1996.

Aerospace Daily, "US Army Studies Ammunition Industrial Base," 11 February 1997.

Bender, Bryan, "Pentagon Says Defense Industrial Base in Good Shape," *Defense Daily*, 6 March 1997.

Benson, Johan, "Interview with Dr. Paul Kaminski," *Aerospace America*, September 1997.

Coats, Dan and Lieberman, Joseph, "A Reformed Military for the 21st Century," *Washington Times*, 1 December 1997, page 23.

Cohen, William S., "Report of the Quadrennial Review," *Joint Forces Quarterly*, Summer 1997.

Cohen, William S., *Defense Reform Initiative*, November 1997.

Cohen, William S., *NATO at 50: New Challenges in a New Age*, 8 February 1998, available from http://www.defenselink.mil/news/Feb1998.html; Internet; accessed 16 March 1998.

Courter, Jim, Steve L. Davis and Loren B. Thompson, "US Military Ammunition Policy: Reliving the Mistakes of the Past," *Parameters*, Autumn 1994.

Decker, Gilbert, *Statement to Congress by the Honorable Gilbert F. Decker, Assistant Secretary of the Army for Research, Development and Acquisition and Lieutenant General Ronald V Hite, Military Deputy to the Assistant Secretary of the Army for Research, Development and Acquisition*, 11 March 1997, available from available from http:www.house.gov/nsc/97-3-11Decker.htm; Internet; accessed 13 January 1998.

Department of the Army, *The Annual Report on the Army After Next Project to the Chief of Staff of the Army*, July 1997.

Department of Defense, Australia-US Reciprocal Defence Procurement Memorandum of Agreement, available from http:iic.spirit.net.au/ imat/publications/moa/moa.htm; Internet; accessed 21 January 1998.

Department of Defense, Armaments Cooperation, Military Critical Technologies List and Assessment, available from http://www.acq.osd.mil/icp/armscoop.html; Internet; accessed 14 March 1998.

Department of Defense, *Defense Science and Technology Strategy*, May 1996.

Dix, Nancy, and Shallman, Mary, *Buy American Act and Trade Agreements Act*, available from http:www.gcwf.com/articles/govbuy.htm; Internet; accessed 23 January 1998.

Doherty, T. J., and Rhoads, R. E., *Analysis Supporting Recommended Strategy for Configuring and Managing the US Munitions Industrial Base*, April 1997.

Doherty, T. J., and Rhoads, R. E., *Recommended Strategy for Configuring and Managing the US Munitions industrial Base*, June 1997.

Donnelly, John, "Munitions Industry Blows up Over Funding Shortfalls," *Defense Week*, 9 September 1996.

Ellsworth, Robert, "American National Security in the Early 21st Century," *US National Security: Beyond the Cold War*, Carlisle Barracks: Strategic Studies Institute, 26 July 1997.

European Union, *Public Procurement*, available from http:europa.eu.int/en/comm/dg01/c2s4.htm; Internet; accessed 23 January 1998.

Foss, Christopher F., "Iranian Armour: Revolutionary surge in Tank Manufacture," *Jane's Defence Weekly*, 14 January 1998

Gansler, Jacques S., "Realizing Acquisition Reform," *Program Manager*, January/February 1998.

Gansler, Jacques S., "Industrial Contraction: Facing the Paradoxes of the Post-cold War," *SAIS Review*, October 1996.

Gansler, Jacques S., Defense Conversion: Transforming the Arsenal of Democracy, Cambridge: The MIT Press, 1995.

Gansler, Jacques S., "Restructuring the Defense Industrial Base," *Issues in Science and Technology*, Spring 1992.

Glashow, Jason, "Lack of Funds may Deplete Stocks of US Army Ammunition," *Defense News*, 8 May 1995.

Gutmanis, Ivars and Starns, John F., "Whatever Happened to Defense Industrial Preparedness?," *Joint Forces Quarterly*, Summer 1997.

Hughes, LTG Patrick M., *Global Threats and Challenges: The Decade Ahead*, 28 January 1998, available from http:www.dia.mil/dr_ssciu.html; Internet; accessed 15 March 1998.

Hull, Andrew, "Trends in the Arms Market," *Jane's Intelligence Review*, 1 May 1997.

Industrial College of the Armed Forces, *In Touch with Industry, ICAF Industry Studies*, Washington: National Defense University, 1996.

Industrial College of the Armed Forces, *In Touch with Industry, ICAF Industry Studies*, Washington: National Defense University, 1997.

Industrial Operation Command, *IOC Manpower-FY98*, available from http://www.ioc.army.mil/rm/iocfact/auth-man.htm; Internet; accessed 18 January 1998.

Industrial Operation Command, *Conventional Ammunition Base Campaign Plan*, received fax 10 February 1998.

Industrial Operation Command, *Industrial Operation Command - Strategic Plan 97*, available from http://www.ioc.army.mil/ea/strat/oldstra; Internet; accessed 9 March 1998.

Institute of Land Warfare, Association of the US Army, *Army Budget Fiscal Year 1998, An Analysis*, Washington, July 1997.

Janik, Richard W., *Exploring Changes to the Ammunition Industrial Base: Facing the Future or Facing Reality*, 24 September 1997.

Kaminski, Paul G., *Preparing for the 105th Congress*, Washington, 13 November 1996, available from http://www.acq.osd.mil/ousda/speech/105th_congress.html; Internet; accessed 17 December 1997.

Kaminski, Paul G., "DoD's Seven-Part Munitions Program," *Defense Issues*, 17 September 1996.

Kennedy, Paul, The Rise and Fall of Great Powers: Economic Change and Military Conflict from 1500 to 2000, New York: Vintage Books, January 1989.

Kennedy, Paul, Preparing for the Twenty-First Century, New York: Vintage Books, 1993.

Kerrigan, Jack, "Message from the Publisher," *Defense News*, 6 August 1995.

Kozmetsky, George, Global Economic Competition, Boston: Kluwer Academic Publishers, 1997.

Lovelace, Douglas C., *The Evolution in Military Affairs: Shaping the Future US Armed Forces*, 16 June 1997, available from http.www.milnet.com/milnet/mil97/emap1.htm; Internet; accessed 17 February 1998.

Munitions Industrial Base Task Force, *Briefing for Members of Congress*, 13 January 1998.

Nash, Trevor, "Armored Enigma in Europe," *Armed Forces Journal International*, May 1996.

National Defense Panel, *Transforming Defense*, December 1997.

Peters, Ralph, "Ruinous General: Heroes Gone Astray," *Army Times*, 16 February 1998.

Pohling-Brown, Pamela, "R&D Spending will Unlock Transatlantic Collaboration," *Jane's Defence Contracts*, 1 June 1997.

Powell, Colin, My American Journey, New York: Ballantine Books, 1995.

RAFAEL Ordnance Systems Division, *Reactive Armor*, available from http://www.rafael.co.il/reactive.html; Internet; accessed 15 March 1998.

Rothacker, Jennifer, *In 1996, US Finished First in Arms Sales*, New York: Associated Press, 17 August 1997.

Science Applications International Corporation, *Munitions Industrial Base Forecast*, Arlington: Strategic Assessment Center, 21 October 1993.

Science Applications International Corporation, *Munitions Industrial Base Investment and Policy Strategy*, Arlington: Strategic Assessment Center, 16 September 1994.

Science Applications International Corporation, *Munitions Industrial Base Task Force, US Conventional Munitions Assessment with Recommendations*, Arlington: Strategic Assessment Center, 27 June 1994.

Science Applications International Corporation, *Strategic Requirements for the US Munitions Industrial Base*, Arlington: Strategic Assessment Center, 2 February 1994.

Shalikashvili, General John M., *Joint Vision 2010*, Washington: Government Printing Office, May 1996.

Shaffer, Jeffrey, and Goure, Daniel, *Avoiding Strategic Hollowness: Recommendation s for the US Munitions Industrial Base*, Washington: The Center for Strategic and International Studies, December 1993.

SNPE Explosives and Propellants, *Reactive Armour*, available from http://www.army-technology.com/contractors/camoflage/snpe/index.html; Internet; accessed on 15 March 1998.

Thrale, Richard, "The Future of the Defense Industry: Remaining Competitive in the International Marketplace," Essays on Strategy (IX), Washington: National Defense University Press, 1993.

Toffler, Alvin and Heidi, War and Anti War, New York: Warner Books, 1993.

Toffler, Alvin and Heidi, The Third Wave, New York: Bantam Books, 1980.

United States Army Advanced Research Laboratory, "Armor/Armaments," *Annual Review of 96 Technical Highlights*, available from http://info.arl.army.mil/EA/armor96.html; Internet; accessed 15 March 1998.

United States Army Audit Agency, *Reforming Ammunition Procurement-Phase I*, 20 March 1997.

United States Army Concepts Analysis Agency, *Briefing to the General Officer Steering Committee*, January 1998.

United States Army, Army Material Command, *Munitions Functional Area Assessment*, 1 April 1997.

United States Army Public Affairs, *Army's Call to ARMS Offers a Model for Defense Conversion*, 2 December 1996.

United States General Accounting Office, *Ammunition Industrial Base, Information on DoD's Assessment of Requirements*, NSIAD-96-133, Washington: Government Printing Office 31 May 1996.

United States General Accounting Office, *Defense Ammunition, Significant Problems Left Unattended Will get Worse*, NSAID-96-129, Washington: Government Printing Office, 21 June 1996.

United States General Accounting Office, *Offset Arrangements*, NSAID-96-65, Washington: Government Printing Office, 12 April 1996.

Vance, Thomas, and Morris, Bill, *Remembering the Heroes of America's Forgotten War: The Korean War*, Washington: Army Public Affairs, 1998.

Volkman, Alfred G., *European Defense Industry Perspectives: The American Viewpoint*, available from http://www.acq.osd.mil/icp/speeches/volkman_europe.htm; Internet; accessed 23 January 1998.

The White House, *A National Security Strategy for a New Century*, May 1997.

Whitehurst, Moses, *The Munitions Industrial Base: Past, Present and Future*, April 1997.

Wolfgram, Paul E., *The Peace Dividend: An Analysis of the Effect of the New DoD Acquisition Policy on the Defense Industrial Base*, 25 May 1993..